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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/634,274

08/05/2003

Paul A. Farrar

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7065

21186

7590

12/22/2005

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EXAMINER

KEBEDE, BROOK

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 12/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/634,274

Applicant(s)

FARRAR, PAUL A.

Examiner

Brook Kebede

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2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 11 October 2005.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-57 and 104-106 is/are pending in the application.
- 4a) Of the above claim(s) 13-57 and 104-106 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 7/5/05.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Drawings*

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the “process the capping layer such that the capping layer completely covers the top of surface of the core conductive layer substantially without being on areas surrounding the core conductive layer,” as recited in claim 1, lines 10-12, must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

*Claim Rejections - 35 USC § 112*

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1-12 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 1 recites the limitation “depositing a capping layer on the core conductive layer after H<sub>2</sub> plasma treatment, the capping layer to **provide a least one property, the property selected form an adhesion property and barrier property,**” in lines 7-8.

However, selection of the property of the capping layer is not disclosed in the specification as originally filed. Therefore, the claim contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 2 recites the limitation “ wherein forming a first conductive layer includes depositing a seed layer on base conductive layer, **the base conductive layer to provide at least on property, the property selected form and adhesion property and barrier property,**” in line 1-2.

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However, selection of **the property** of the **conductive layer** is not disclosed in the specification as originally filed. Therefore, the claim contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claims 2-12 are also rejected as being directly or indirectly dependent of the rejected independent base claim.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 1-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation “depositing a capping layer on the core conductive layer after H<sub>2</sub> plasma treatment, the capping layer **to provide a least one property, the property selected form an adhesion property and barrier property,**” in lines 7-8.

However, the limitation “**the property selected form an adhesion property and barrier property**” is lacks clarity in meaning and scope for the following reasons:

It is not clear how one having ordinary skill in the art can select the property of the material after the fact forming the material. One having ordinary skill in the art can select a material that inherently has certain property for the intended purpose. However, it is not clear how one having ordinary skill in the art can select property of the material after the fact the material is already exist.

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Therefore, the claim is indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 2 recites the limitation “ wherein forming a first conductive layer includes depositing a seed layer on base conductive layer, **the base conductive layer to provide at least on property, the property selected form and adhesion property and barrier property,**” in line 1-2.

The recited claim lacks clarity in its meaning and scope because it is not clear that how on of ordinary skill in the art would select the property of the material rather than selecting the material that inherently provides certain properties.

Therefore, the claim is indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 2-12 are also rejected as being directly or indirectly dependent of the rejected independent base claim.

Applicant’s cooperation is requested in reviewing the claims structure to ensure proper claim construction and to correct any subsequently discovered instances of claim language noncompliance. See *Morton International Inc.*, 28USPQ2d 1190, 1195 (CAFC, 1993).

**In light of the rejection 35 U.S.C. § 112 second Paragraph that set forth herein above, the following 35 U.S.C. 103 rejection is based on prior art which reads on the interpretation the claim language of the instant application as best as understood by the Examiner.**

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Farr (US/6,376,370) in view of Agnello et al. (US/6,255,217).

Re claim 1, Farrar discloses a method for forming an electronic device comprising: forming a first conductive layer (320) (see Fig. 3F) in an opening (310) in a dielectric structure (308) supported by a substrate (300); forming a core conductive layer (344) having a top surface (see Fig. 3K) on the first conductive layer (320); and depositing a capping layer (346) (i.e., TiN barrier layer ) on the core conductive layer (344), wherein the capping layer (346) is completely covers the core conductive layer (344) (see Fig. 3K) without being on the areas surrounding the core conductive layer (344) (i.e., the capping layer 346 is exclusively formed on top of the core conductive layer 344) (see Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7).

However, Farrar does not disclose subjecting the conductive core layer to a H<sub>2</sub> plasma treatment prior formation of the capping layer.

Agnello et al. disclose method for forming an electronic device comprising depositing of the core conductive layer (20) (i.e., copper layer) into the opening (see Fig. 1) and treating the surface of the core conductive layer with hydrogen plasma (see Col. 2, line 21-56) prior to depositing of an inorganic barrier (capping) layer (24) in order to increase surface adhesion of the of the inorganic barrier to the copper conductive layer (see Col. 2, lines 33-56).

Both Farrar and Agnello et al. teachings are directed to method of fabricating copper damascene interconnect devices. Therefore, the teachings of Farrar and Agnello et al. are analogous.

Hence, one of ordinary skill in the art would have been motivated to look to analogous art teaching hydrogen plasma treatment of copper wire layer prior formation of the barrier layer as disclosed by Agnello et al. in order in order to increase surface adhesion between the copper wire and the barrier layer while reducing the native oxide that formed on the copper layer.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of applicant(s) claimed invention was made to provide Farrar reference with teaching hydrogen plasma treatment of copper wire layer prior formation of the barrier layer as taught by Agnello et al. in order to increase surface adhesion between the copper wire and the barrier layer.

Re claim 2, as applied to claim 1 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein forming a first conductive layer (320) includes depositing a seed layer (316) base conductive layer (320) and the barrier layer (314) provided there between (see Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).

Re claim 3, as applied to claim 2 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein depositing a seed layer on a base conductive layer includes depositing the seed layer on a layer of a refractory metal, a compound of nitrogen and a tantalum alloy, or a compound of nitrogen and a tungsten alloy (see Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).



Re claim 4, as applied to claim 2 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein depositing the seed layer and the capping layer includes depositing the seed layer and the capping layer using low energy ion implantation (see Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).

Re claim 5, as applied to claim 4 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein depositing the seed layer and the capping layer using low energy ion implantation includes using an implant energy ranging from about 0.1 keV to about 0.8 keV (i.e., within the overlap claimed region of 0.1 keV to 2 keV) (see Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).

Re claim 6, as applied to claim 1 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein forming a core conductive layer includes depositing the core conductive layer using a CVD process (see Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).

Re claim 7, as applied to claim 1 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein forming a core conductive layer includes forming the core conductive layer at predetermined temperature. Furthermore, the claimed temperature range can be optimized by routine experimentation in order to achieve the desired thickness and surface roughness of the conductive layer (see Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).

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One of ordinary skill in the art would have been motivated to optimize the deposition temperature of the conductive layer by using routine experimentation in order to achieve the achieve the claimed temperature range.

Therefore, it would have been to one having ordinary skill in the art at the time of the invention is made to deposit the copper conductive layer at temperature range of room temperature to 250 C, since it has been held where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.” See *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955); *In re Hoeschele*, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969); *Merck & Co. Inc. v. Biocraft Laboratories Inc.*, 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied, 493 U.S. 975 (1989); *In re Kulling*, 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990); and *In re Geisler*, 116 F.3d 1465, 43 USPQ2d 1362 (Fed. Cir. 1997). Furthermore, the specification contains no disclosure of either the critical nature of the claimed temperature range or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. See *In re Woodruff*, 919, f.2d 1575, 1578, 16 USPQ2d, 1936 (Fed. Cir. 1990).

Re claim 8, as applied to claim 1 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein depositing a capping layer includes depositing one or more materials selected from titanium, zirconium, hafnium, and nitrides of these elements (see Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).

Re claim 9, as applied to claim 1 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein depositing a capping adhesion/barrier layer includes depositing the capping layer having a thickness range of 5 Å to 150 Å (i.e., within the claimed range of ranging from about 5 Å to about 40 Å) (see Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).

Re claim 10, as applied to claim 1 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein the method further includes removing at least a portion of the dielectric structure, after depositing the capping layer on the core conductive layer, to form an air bridge structure (see Farrar Col.5, lines 7-8) (see also Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).

Re claim 11, as applied to claim 1 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein forming a core conductive layer and depositing a capping layer includes forming the core conductive layer and depositing the capping layer in the opening in the dielectric structure, the dielectric structure having multiple dielectrics layers, such that the core conductive layer and the capping layer are within one dielectric layer in the dielectric structure with a top surface of the capping layer substantially level with a top surface of the one dielectric layer (see Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).

Re claim 12, as applied to claim 11 above, Farrar and Agnello et al. in combination disclose all the claimed limitations including the limitation wherein forming the core conductive

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layer and depositing the capping adhesion/barrier layer within one dielectric layer includes forming the core conductive layer and depositing the capping within a polymer layer, a foamed polymer layer, a fluorinated polymer layer, a fluorinated oxide layer, or an aerogel layer (see Farrar Figs. 3A-3K and related text Col. 15, line 18 – Col. 20, line 7 and Agnello et al. Fig. 1; Col. 2, line 21-56).

### *Response to Arguments*

8. Applicant's arguments filed on October 11, 2005 have been fully considered but they are not persuasive.

With respect claims 13-17, 20, 23, 25-31, 37, 39-42, 44-50 and 52-55, applicant's contention of that these claims are properly linked with claim 1 and these claims should be allowed with allowance of claim 1 has no merit because there is no allowable linking claim can be found in claim 1.

With respect to claims rejection of claim 1-12 under 35 U.S.C 103(a), applicant argues that "the combination of Farrar and Agnello et al. do not teach or suggest a method including processing a capping layer such that the capping layer completely covers the top surface of the core conductive layer substantially without being in the areas surrounding the core conductive layer..."

In response to applicant's argument, it is respectfully submitted that the combination of Farrar '370 and Agnello et al. '217 disclose all the claimed limitations including the limitation "processing a capping layer such that the capping layer completely covers the top surface of the core conductive layer substantially without being in the areas surrounding the core conductive layer." This feature is clearly depicted on Fig. 3K of Farrar '370. In addition, applicant's

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argument in this particular claimed future should not given any patentable weight because applicant's own disclosure does not have a support for the newly added claimed language. Apparently the drawings are objected as set forth in Paragraph, 1 above and depending upon applicant's response the claims may be rejected under new matter ground.

Therefore, the *prima facie* case of obviousness has been met and the rejection under 35 U.S.C. § 103 is deemed proper.

### ***Conclusion***

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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*Correspondence*

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brook Kebede whose telephone number is (571) 272-1862. The examiner can normally be reached on 8-5 Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S. Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

*Brook Kebede*

Brook Kebede  
Primary Examiner  
Art Unit 2823

BK  
December 21, 2005